Pollution from historic landfill sites

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1. Introduction

Background: In England and Wales 4748 historic landfill sites are within flood zone 3[1]. Therefore, there exists the potential for contaminants to leach into the aquatic environment or for solid waste materials to erode and become incorporated into sediments. Many of these sites are protected by flood defences and some form part of the flood defence network. The presence of landfill waste places considerable pressure on coastal and riparian managers to maintain or strengthen these flood defences rather than adopting more sustainable management policies, such as de-embankment. Selecting alternative management policies for these sites requires an understanding of the contaminants within the landfill waste and their potential to be released. Leaching from landfills in freshwater environments is well studied, but leaching from landfills in saltwater environments is not. In addition, previous studies have focused on leachates without considering the contaminant load of the solid waste and whether it poses a pollution risk if eroded.

Aim: The purpose of this research was to address these knowledge gaps by analysing contaminant concentrations in waste from historic landfill sites, and determining whether there is a difference in metals released by waste in freshwater and saltwater environments.

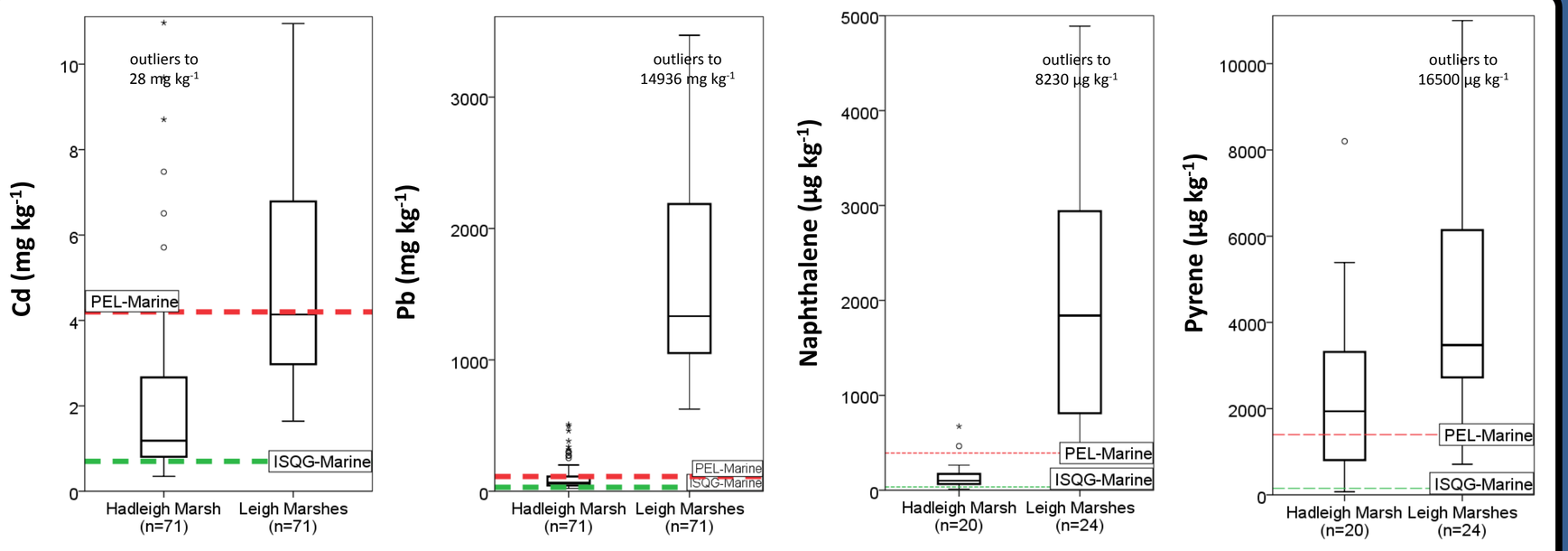

Fig. 2: Contaminant concentrations in matrix material samples compared to Canadian sediment quality guidelines[2].

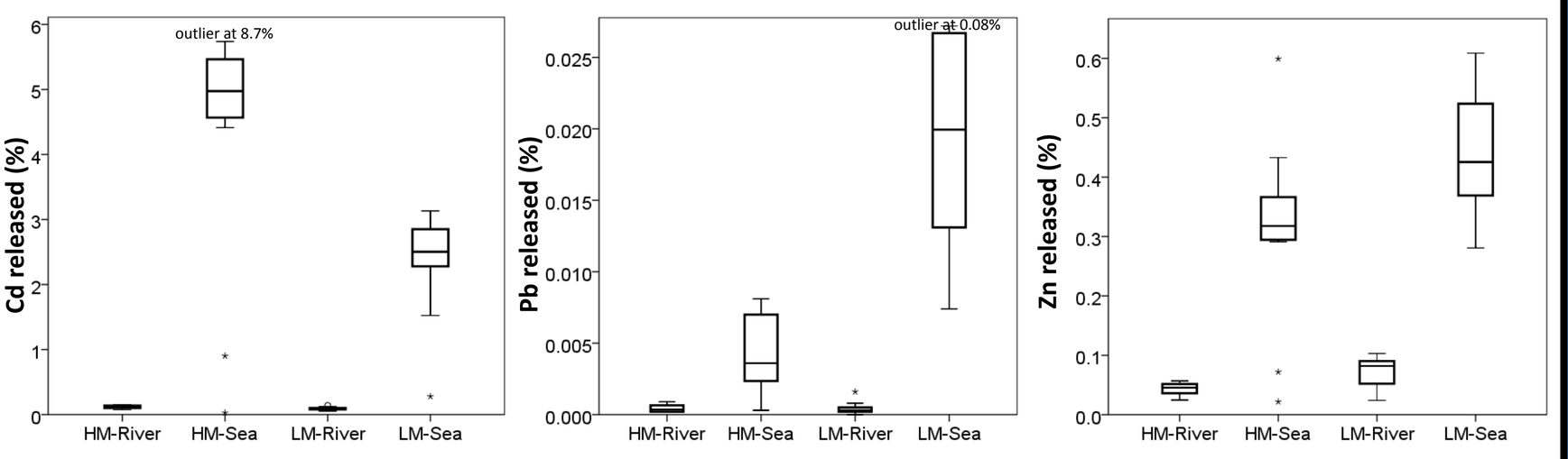

Fig. 3: Proportions of metals released from matrix material samples during 24 hour leaching experiments (all n=12).

2. Methodology

Landfill waste samples were excavated from two historic landfill sites on the Thames Estuary in Essex: Hadleigh Marsh waste filled flood embankment and Leigh Marshes recreational area (fig. 1 and plate 1).

Metal concentrations in waste: matrix material, wood, paper and textile samples were sorted, dried, digested using aqua regia, and then analysed for a suite of major and trace metals using ICP-OES and ICP-MS (only matrix material results are presented here).

PAH concentrations in waste: matrix material samples were analysed by the EA's National Laboratory using GC-MS.

Metal release in water: 24 hour batch leaching experiments were undertaken in deionised water (to represent river water) and artificial seawater using matrix material samples. Leachates were analysed using ICP-MS.

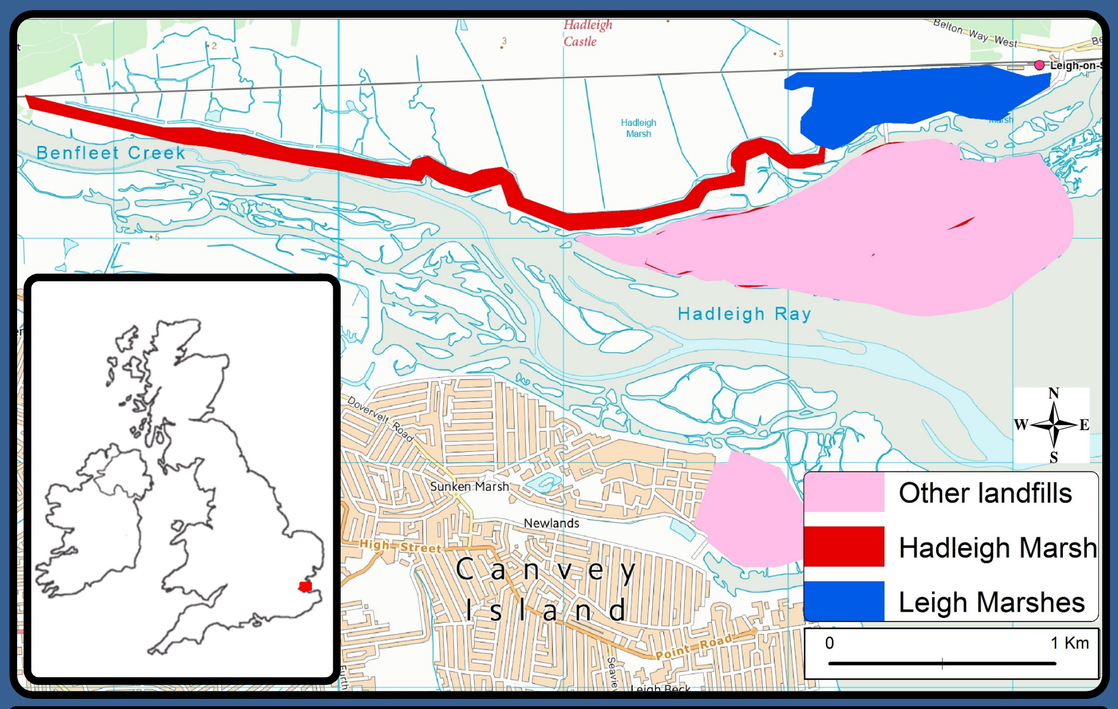

Fig. 1: Primary study sites– Hadleigh Marsh waste filled embankment and Leigh Marshes, a recreational area created from a closed landfill site (EA, 2013; Scottish Sensory Centre, 2013).

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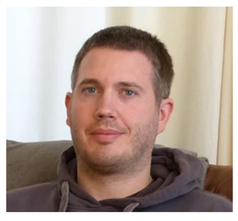

Further information

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3. Key findings

Metal and PAH concentrations in waste (fig. 2):

- Contaminant concentrations in the waste are highly heterogeneous and there are significant differences in concentrations between trial pits within the same landfill site and between landfill sites:
  - results from one site are not representative of other sites.
- Contaminant concentrations in the Hadleigh Marsh samples exceed interim sediment quality guidelines (ISQGs):
  - there would be some adverse biological effects if the waste eroded and incorporated into sediment.
- Contaminant concentrations in the Leigh Marshes samples exceed probable effects levels (PELs):
  - there would be frequent adverse biological effects if the waste eroded and incorporated into sediment.

Metal release (fig. 3):

- Significantly different proportions of metals were released from waste from different landfill sites:
  - data from one landfill site cannot be used to predict metal release at another landfill site.
- Significantly higher concentrations of metals are released in seawater compared to deionised water:
  - significantly increased concentrations of metals can be expected to be present in leachates from historic estuarine landfills as saline intrusion into estuaries increases due to climate change effects.
- Cd and Zn in the seawater leachates exceed Landfill Directive Waste Acceptance Criteria inert limits, but:
  - water EQSs would not be exceeded for these sites due to dilution of leachates within the Thames Estuary.
  - leaching from other sites into smaller waterbodies may have an adverse effect upon water quality.

4. Future research

Development of a method for ranking the pollution risk of historic coastal landfills to enable the prioritisation of resources for further investigation or remediation.

Plate 1: Excavating samples from Hadleigh Marsh waste filled flood embankment (27th March 2014).

References and footnotes: [1]Land with annual probability of river flooding ≥ 1% or sea flooding ≥ 0.5% (http://apps.environment-agency.gov.uk/wiyby/37837.aspx). [2]Canadian Council of Ministers of the Environment 2002. Canadian sediment quality guidelines for the protection of aquatic life.
Maps: Environment Agency 2013. What's in your backyard, available from http://www.environment-agency.gov.uk/homeandleisure/37829.aspx Scottish Sensory Centre 2013. British Isles outline, available from http://www.ssc.education.ed.ac.uk/resources/viandmulti/hinton/pic5.gif